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ABSTRACT

A position statement on the use of calculators was published in 1991 in which the NCTM (National Council of Teachers of Mathematics) strongly urged that calculator usage be promoted by school districts, teachers at every level, authors, and educators. In the 2000 publication of Principles and Standards for School Mathematics, NCTM noted that "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning." In view of NCTM's position on computer and calculator use, there is a need to know how available computers and calculators are in schools, how they are being used, and to what extent. Based on a literature review, the paper reveals that the number of computers and calculators in the schools has grown and will continue to grow and the computers that are now in the schools are not being fully utilized. Text processing tools appeared to be the most common use of computers in school. Calculators appeared to be used mostly for checking paper-and-pencil calculations, developing skills at estimation, and problem solving. Several studies found that teacher training was an important factor in computer use and the fear that traditional skills would not be learned was an important factor in calculator use. Results of the literature review strongly suggest that computers and calculators have been forcing curriculum planners to critically examine the content and methods of teaching secondary school mathematics. Too many teachers are not adequately trained in technology integration or in favor of unrestricted use of calculators. (Contains 18 references.) (MM)

Computers and Calculators in Schools: A Status Report

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In 1987 the National Council of Teachers of Mathematics (NCTM) published a position statement in which they called for changes in mathematics curriculum, instructional methods, and access to computer hardware and software. In the 1989, NCTM also proposed a balanced curriculum with greater emphasis on conceptual development, mathematical reasoning, and problem solving. NCTM also recommended that teachers learn how to integrate technology into the mathematics curriculum. A position statement on the use of calculators was published in 1991 in which NCTM strongly urged that calculator usage be promoted by school districts, teachers at every level, authors and educators. In the 2000 publication of Principles and Standards for School Mathematics, NCTM noted that "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning." In view of NCTM's position on computer and calculator use, there is a need to know how available computers and calculators are in schools, how they are being used and to what extent.

In order to ascertain a clear perception of the present uses of computers and calculators in schools, various sources were consulted including journals articles, books, and dissertations. An on-line computerized literature search was conducted using Educational Resources Information Center (ERIC). Some of the areas in which the literature search produced information were: Computers in education, technology integration, and computers/calculators in mathematics education.

Based on the literature reviewed, the number of computers and calculators in the schools has grown and will continue to grow and the computers that are now in the schools are not being fully utilized. Text processing tools appeared to be the most common use of computers in school. Calculators appeared to be used mostly for checking paper-and-pencil calculations, developing skills at estimation, and problem solving. Several of the cited studies found that teacher training was an important factor in computer use and the fear that traditional skills would not be learned was an important factor in calculator use. It appeared that computers and calculators are forcing curriculum planners to critically examine the content and methods of teaching secondary school mathematics. Too many teachers are not adequately trained in technology integration or in favor of unrestricted use of calculators.

Literature Review
Computers and Calculators in Schools: A Status Report

Statement of Problem

In 1987 the National Council of Teachers of Mathematics (NCTM) published a position statement in which they called for changes in mathematics curriculum, instructional methods, access to computer hardware and software, and teacher education that places emphases on the use of computers. In 1991, NCTM published a position statement on the use of calculators in which they strongly urged that calculator usage be promoted by school districts, teachers at every level, authors and educators.

In the 1989, in addition to an emphasis on the use of computers and calculators, NCTM also proposed a balanced curriculum with greater emphasis on conceptual development, mathematical reasoning, and problem solving, and less emphasis on computational and manipulative proficiency. NCTM recommended that teachers learn how to integrate technology into the mathematics curriculum. In the 2000 publication of Principles and Standards for School Mathematics, NCTM noted that "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning."

There is a need to know the availability of computers and calculators in schools, how they are being used and to what extent.

Method of Selecting Relevant Articles/Studies

In order to ascertain a clear perception of the present uses of computers and calculators in schools, various sources were consulted including journals articles, books, and dissertations. An on-line computerized literature search was conducted using Educational Resources Information Center (ERIC). Some of the areas in which the literature search produced information were: Computers in education, technology integration, and computers/calculators in mathematics education.

Findings and Implications

The literature review of topics relevant to the problem is divided into four sections. The first section considers the availability of computers and calculators in schools. It appeared that the number of computers and calculators in the schools had grown and will continue to grow and that the computers that are now in the schools are not being fully utilized.

The second section concerns computer and calculator uses in the schools. Text processing tools appeared to be the most common use of computers in school. Calculators appeared to be used mostly for checking paper-and-pencil calculations, developing skills at estimation, and problem solving.

The third section discusses factors affecting computer and calculator use in schools. Several of the cited studies found that teacher training was an important factor in computer use. The fear that traditional skills would not be learned was an im1portant factor in calculator use.

The fourth section concerns the role of computers and calculators in secondary mathematics education. It appeared that computers and calculators are forcing curriculum planners to critically examine the content and methods of teaching secondary school mathematics.

The Availability of Computers and Calculators in Schools

Computers

It has been more than thirty years since educators began using computers for instructional purposes. Since that time, the availability and accessibility of computers in the classroom have continuously grown throughout the United States and they are used virtually throughout the K-12 Curriculum (Posamentier & Stepelman, 1999). Bruder, Romero, Blinken, and Beudert (1993) reported that the student to computer ratio, in 1992, had escalated to one computer for every 16 students. At the same time they reported that the gap between the haves and the have-nots was as large as ever despite the effort on the part of the have-nots to increase their spending on hardware, software and training. Today, according to Orlich, Harder, Callahan, and Gibson (2001), there is one personal computer for every 10 students in U. S. public schools. According to a survey implemented by the National Center for Education Statistics, 99% of all public school teachers reported having computers available somewhere in their schools and 84% of all public school teachers reported having them in their classrooms. Only about half of the teachers with computers available in their schools used them for classroom instruction and teachers were more likely to use the computers when the computers were available to them, in their classrooms as opposed to computer labs, and available in great numbers (Smerdon, Cronen, Lanahan & Anderson, 1999). Although the student to computer ratio has steadily decreased, many schools have limit access to computers and the World Wide Web. In spite of the fact that congress and state governments have implemented plans to increase access through e-rate and other technology programs, the digital divide is still significant (Bitter & Pierson, 1999).

Calculators

As the 1980s began, half the schools in the United States had declared a formal policy with regard to calculator use. A few states had gone so for as to mandate their implementation, twelve states had proposed that calculators be used in testing and two states restricted calculator implementation to upper grades (7 - 12). However, the typical policy, at that time, recommended calculator use across the entire spectrum, emphasizing the calculator as a tool, but not as an object of study (kansky, 1987). Today, calculator use in U. S. schools is more widespread than it was in the 80s. Calculators have become quite inexpensive, are available to many students, and are used regularly outside of school. Many school boards and k-12 math teachers have adopted the 1991 National Council of Teachers of Mathematics (NCTM) Curriculum and Evaluation Standards which recommended that every teacher at every grade level promote the use of calculators to enhance mathematics (Starr, 1998). Resistance to calculator use has diminished, but not to the point where everyone is comfortable with their use (Van de Walle, 2001).

Computer and Calculator Uses in Schools

Computers

A survey of administrators and teachers in the Arkansas secondary schools, conducted by Sutherlin (1990), in an effort to determine the ways computers were being used indicated that computers were primarily used in administration, business education and computer science. Teachers used computers most often for management tasks, such as test preparation. In the majority of the schools, the computers were used less than an estimated 30% of the time.

According to the 1999 survey of the National Center for Education Statistics, 99% of the public school teachers reported computer availability in their schools and indicated that they used computers or the Internet at school for communicative purposes and to accomplish a number of preparatory and administrative tasks. The communicative purposes included communicating with colleagues, parents, students, and posting homework/assignments. Fifty percent of the times teachers used computers or the Internet to communicate, it was used for communicating with colleagues compared to 25% with parents, 12% with students, and 17% for posting homework or assignments. The preparatory tasks included: (1) creating Instructional materials, (2) gathering information for lesson plans, (3) accessing best practice examples, (4) preparing multimedia presentations for class, and (5) accessing model lesson plans. The administrative tasks included only administrative record keeping. Seventy-eight percent of public school teachers used computers or the Internet at school to create instructional materials, and 59% of teachers reported using computers or the Internet at school to gather information for planning lessons. Thirty-seven percent used computers or the Internet at school for accessing research and best practice examples. Where as, 36% used computers or the Internet at school for preparing multimedia presentations for class. Thirty-four percent used computers or the Internet at school for accessing model lessons plans and 51% of the teachers used computers or the Internet at school for administrative record keeping.

In addition to communication, preparation of instruction and administrative tasks, teachers also used computers or the Internet for instructional activities in the classroom. Fifty-three percent of public school teachers indicated that they used computers or the Internet for instruction during class time. Elementary teachers were more likely to do this than secondary teachers (56% compared to 44%) and teachers in schools with high minority enrollment were generally less likely to use computers or the Internet for instruction during class time than teachers in schools with low minority enrollments (Only 45% of teachers in schools with 50% or more minority students compared with 56% of teachers in schools with less that 6% minority).

Teachers were asked how often they used computers or the Internet during class time and assigned student to use these technologies for projects and various other activities, including: word processing/spreadsheets, Internet research, practice drills, solving problems/analyzing data, CD-ROM research, multimedia projects, graphical presentations, demonstration/simulation, and correspondence with experts.

Public school teachers assigned students to use computers or the Internet for word processing/ spreadsheets most frequently (61% did this to some extent), followed by Internet research (51%),

practice drills (50%), solving problems and analyzing data (50%), CD- ROM research (48%), multimedia projects (45%), graphical presentations (43%), demonstration and simulation (39%), and correspondence with experts (23%). An Overall 53% of public school teachers assigned projects using the computer or Internet inside of the classroom.

Calculators

When used appropriately, the overall results of calculators as learning tools seemed to be positive. Calculators were mostly used for activities that aided students in connecting what they learn in school to real-world situations. Calculators were used to work with numbers that were difficult to manipulate, to organize data, and to display graphs. Students also used calculators to experiment with different ways of solving problems, examine mathematical models, study trends in data, and check the accuracy and the reasonableness of their thinking.

Factors Affecting Computer and Calculator Use in Schools

The barriers to the use of computers and the Internet for instruction most frequently reported by public school teachers were not enough computers (78%), lack of release time for teachers to learn how to use computers or the Internet (82%), and lack of time in schedule for students to use computers in class (80%. In addition, 71 percent reported the lack of good instructional software, and 58% of teachers reported difficult Internet access as barriers. Approximately two-thirds of all teachers reported the lack of adequate equipment, training opportunities, technical support or advice, and support regarding ways to integrate telecommunications into the curriculum as barriers (66%, 67%, 64%, and 68%, respectively). Fifty-nine percent also reported that a concern about student access to inappropriate materials was a barrier. Lack of administrative support was least likely to be reported as a barrier (43%). Teachers with more years of experience were generally more likely to cite the lack of release time to learn, practice, or plan ways to use computers or the Internet as a barrier than less experienced teachers.

Calculators

Depending on one's view of calculator use, particularly at the elementary school level, calculator use was seen as either the solution to or the cause of many of the problems students encountered in mathematics education (Starr, 1998). Some of the claims made by proponent of calculator use were: calculators allow students to spend more time on understanding concepts and problem solving rather than on tedious calculations, and 2) the use of calculators helps students develop a sense of confidence about their math abilities (Starr, 1998). While some critics of calculator use claimed that: 1) calculator use prevents students from understanding many underlying mathematical concepts, and 2) calculator use give students a false sense of confidence about their true mathematical ability.

The Role of Computers and Calculators in schools

Computers

Computers and/or computer-related technologies were being used in k-12 education to provide instructional activities that mimic real-life situations, provide for active student involvement, and for discovery learning. The computer-related technologies include CD-ROMs, DVD-ROMs, application software, multimedia applications, electronic books, laserdiscs, and communications applications.

Teachers were shifting from the conventional lecture-practice-recall teaching methods to being a facilitator of learning. A facilitator of learning motivates students to want to learn, guide the student learning process, and promotes a learning atmosphere as well as an appreciation for the subject.

Calculators

Calculators were also being used in schools to provide instructional activities that mimic real-life situations, provide for active student involvement, and for discovery learning. Calculators were generally not used to replace the need to learn basic facts. However, they were used to remove some of the tediousness of tasks like graphing and long pencil-and-paper computations. A variety of calculators were being used in schools, ranging from simple four-function calculators that add, subtract, multiply, and divide to calculators that display tables and graphs and do algebra.

Teachers tended to use student-centered lessons for activities in which calculators were to be used. The teachers remain involved in the instructional process by giving directions but turn the responsibility of finding solutions and developing ideas over to the students during the lesson (Van de Walle, 2001).

Summary

The world has changed because of technology, and computers and calculators are important parts of that change. In the world outside school, computers and calculators are used frequently. Society expects students to learn how to used computers and calculators to complete tasks. When computers and calculators are placed in the hands of teachers and students, effective and powerful opportunities for many different types of instruction and learning can and do take place (Shelly, Cashman, & Gunter, 1999).

Several leading professional organizations support educators in the use of technology in schools. Two such organizations are the International Society for Technology in Education (ISTE) and the National Council of Teachers of Mathematics (NCTM). ISTE has developed National Educational Technology Standards for Students (NETS Project, 2000a) and for Teachers (NETS Project, 2000b). The goal of the NETS Project is to provide educational leaders with direction for recognizing and addressing the essential conditions for effective use of technology to support PK-

12 education (ISTE, 2000a).

In 2000, NCTM released the Principles and Standards for School Mathematics in which there is a technology principle. The Principles describe special features of high-quality mathematics education and the Standards describe the content and processes that students should learn in PK-12 (NCTM, 2000).

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